

BRIEF

Evaluation of a Fourth-Year Student Pharmacist Research Process at a Community Teaching Health System

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Objective. To evaluate a process developed to support research by fourth-year student pharmacists enrolled in an advanced pharmacy practice experience at a health system affiliated with a school of pharmacy.

Methods. In 2017, clinical, non-tenure track faculty transitioned from facilitating a fourth-year research elective to implementing a new student research process that matches students to research preceptors at the beginning of the academic year and provides training and resources to them throughout the year. This pre-post study evaluated student pharmacist research participation, dissemination, and placement into a residency or job position at the time of graduation, and then compared data for the three years before the new process was implemented to data for the three years after implementation.

Results. Thirty-three fourth-year students assigned to the health system graduated from 2015 to 2017, and 31 graduated from 2018 to 2020. The percentage of students in each cohort who completed research projects increased significantly (48.5% vs 87.1%), the number of projects increased significantly (18 vs 35), the number of presentations increased significantly (29 vs 63), and the number of publications increased significantly (9 vs 20). The percentage of research students who pursued postgraduate training increased (68.8% vs 96.3%), as did their rate of placement into training programs (81.8% vs 92.3%). Of those students who did not participate in research, the percent who pursued training also increased (17.6% vs 75%), but the rate of placement remained the same (66.7%).

Conclusion. Matching fourth-year student pharmacists to research preceptors at the beginning of the academic year and providing them with training and resources throughout the year was associated with increased research productivity.

Keywords: student research, student pharmacist, advanced practice experience, scholarly activity, research preceptor

INTRODUCTION

Student pharmacists' participation in research improves high-level skills, including problem-solving, critical thinking, communication, leadership, collaboration, and innovation.¹ These abilities are assets as research has demonstrated positive patient outcomes resulting from pharmacist integration on the health care team. Research skills also support a pharmacist's career advancement and advances the profession.¹ Positive associations have been identified between student pharmacists' participation in

research and increased likelihood of pursuing postgraduate and specialty training, continuation to faculty appointment, and lifetime publication rate.¹

The benefits of scholarship to the profession are valued by pharmacy organizations such that Doctor of Pharmacy programs are encouraged to incorporate research training into their curricula.¹⁻³ Pharmacy schools use lectures, elective and required courses, and dual-degree programs to teach research skills to student pharmacists. However, most schools and colleges of pharmacy do not require students to participate in hands-on research. Faculty face ever-increasing workloads, while students experience time constraints, as they juggle academic rigor with work and leadership roles to remain competitive for potential postgraduate opportunities. Therefore, it is imperative

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to examine strategies for fostering student pharmacist research. A retrospective cohort study of 1229 student pharmacists found that student research participation and scholarly productivity increased significantly from 2009-2015 compared to 2002-2008. The increase was attributed to students beginning feasible projects early in the professional program, receiving dedicated mentorship from motivated non-tenure track practice faculty, and being given group project opportunities.¹

There are some studies in the pharmacy literature describing the outcomes of longitudinal student pharmacist research programs. A pre-post study (N=65) of a longitudinal, 12-month research experience found a six-fold increase in the number of national poster presentations (an increase from 6 to 36, $p < .01$) during the five years after implementation of the experience compared to the five years prior, with a significant increase in projects benefiting practice (57.1% vs 83.3%, $p = .03$).⁴ In another study involving a research-based APPE, of the 80 students who participated, all presented posters and two projects were published in peer-reviewed journals. Students' perception of the experience was positive, with some stating it allowed them to apply research findings to real-world scenarios.⁵ In a large academic medical center, a research program was implemented for student pharmacists in their first, second, or third year.⁶ The number of student research participants per year was substantially higher in 2013 compared to 2009, (16 vs 2, respectively), and the number of posters and publications increased from 1 to 19 and 0 to 2, respectively.

More insight into the strategies adopted by health systems to support student research may be helpful for experiential sites with limited resources and/or affiliations. The objective of this study was to describe a new fourth-year student pharmacist research process implemented in a moderate-sized health system affiliated with a university-based college of pharmacy, and report the outcomes, including student research participation, dissemination, and postgraduate training and job placement at the time of graduation.

METHODS

From 2014 to 2017, pharmacy educators from a community teaching health system facilitated a four credit-hour research elective for fourth-year advanced pharmacy practice experience (APPE) students who were assigned to the health system from an affiliated university. Prior completion of drug literature evaluation and statistics courses were prerequisites for this course in which didactic sessions and resources covering research topics were provided throughout the year. Each student was expected to identify a mentor, complete a longitudinal research

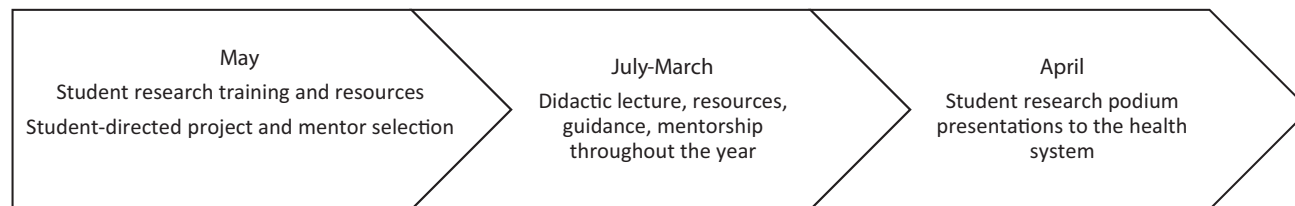
project for which institutional review board (IRB) approval was obtained, present a poster at a pharmacy conference, and provide a 10-minute podium presentation to health-system pharmacy personnel. Assistance was provided to students as needed throughout the year.

In 2017, the research elective was discontinued and a clinical faculty member implemented a new process to support research by fourth-year APPE students. No prerequisites were required for students to participate in the new process, which did not provide course credit but proactively matched students with mentors who had mutual research interests. In March each year, the faculty, who also served as chair of the health-system pharmacy research committee (PRC), requested preceptors to submit student research project interests. Preceptors stemmed from diverse areas, ranging from administration, community pharmacy, and generalist clinical practice (inpatient and primary care) to inpatient and outpatient specialties (eg, oncology, cardiology, infectious diseases, pediatrics). The clinical faculty received 10 to 15 preceptor submissions each year, and each preceptor mentored or co-mentored one student project per year. The PRC, which is a departmental continuous quality improvement committee overseeing pharmacy-led research projects, reviewed preceptor project ideas and provided constructive feedback to each preceptor to optimize the feasibility of each project. Feedback from the PRC included advising students to seek committee approval (ie, Pharmacy & Therapeutics approval of order sets), obtain informed consent, and/or utilized data reports for process implementation. The PRC also encouraged preceptors to develop practical study designs, incorporate diverse outcomes (ie, quality, financial), review whether the implementation timeline fit the academic calendar, and develop a secure process for data collection. Educational opportunities for health-system preceptors expanded to include continuing education covering research training topics.

In May, students were asked to share their top three research interest areas. The faculty then matched students, starting with their first choice, to preceptors who had submitted similar interests earlier in the year, co-taught with IRB coordinators to provide students one hour of research training (Figure 1), required students to complete the Collaborative Institutional Training Initiative course, and required students to sign a research agreement with their mentor that described their responsibilities and the estimated number of hours they would need to dedicate to the research process.

Throughout the year, the faculty provided information about resources (eg, statistician, data analytics, information technology) and education available within the health-system (eg, live education provided by preceptors,

Previous process (2015-2017)



New process (2018-2020)

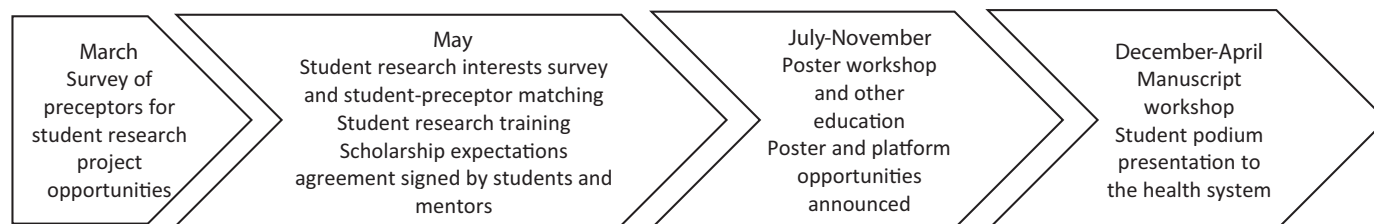


Figure 1. Timeline for faculty and preceptors providing support for fourth-year student pharmacist research projects.

electronic medical record training, resident research discussions), notification of local, state, and national poster and platform presentations; and workshops covering abstract development, poster presentations, and manuscript writing. The faculty announced these opportunities via email or during in-person or virtual student meetings and emailed the students as a group at least monthly to offer students help with their research. The faculty also encouraged students to complete a poster presentation and a year-end 10-minute health-system pharmacy platform presentation.

This study was approved by the Cone IRB. This was a pre-post study that compared the three years before to the three years after implementation of the new student research process. The primary outcome was the percent of fourth-year student pharmacists assigned to the health-system who completed research projects. Secondary outcomes included posters, podium presentations, publications, and postgraduate training or job placement at the time of graduation.

At the end of each academic year, the faculty sent an email to students inquiring about scholarly activity and position placement (any postgraduate training program or job by the time of graduation). Data for posters, publications, and presentations were collected using student self-report, Scopus, and MEDLINE (PubMed). Position placement at graduation was collected by student self-report. Data were analyzed using the Fisher exact test, paired *t* tests, and descriptive statistics using Number Cruncher Statistical Systems (Kaysville, UT 2015).⁷

RESULTS

Thirty-three fourth-year students from the classes of 2015-2017 completed an APPE at the health system, and

31 students from the classes of 2018-2020 completed an APPE at the health system (Table 1). The percent of students that participated in research within the health system increased from 48.5% for 2015-2017 to 87.1% for 2018-2020 ($p=.001$), and the number of research projects increased from 18 to 35 ($p=.005$). Research dissemination increased significantly from a mean of 1.2 per student to 2.5 per student ($p<.001$), including a significant increase in presentations from 29 to 63 ($p<.001$), and publications from nine to 20 ($p=.032$).

Of the 43 students who completed research projects, the percentage who pursued training (residency or fellowship) increased from 68.8% to 96.3% (Table 2). Of these, 37 total students pursued training during both time periods, and the rate of those placed into a training program increased from 81.8% to 92.3%. Of 21 students who did not complete research projects, the percentage who pursued training also increased from three years before to three years after implementation (17.6% vs 75%), but the placement rate remained the same during both time periods (66.7%).

DISCUSSION

Implementation of a new student research process was associated with a significant increase in productivity. Compared to the previous research process, which began in May each year and placed the onus on students to develop a project and identify a mentor, the new process engaged preceptors interested in conducting research prior to students' arrival and provided educational opportunities for preceptor research training. Preceptors then developed project ideas, received feedback from the PRC, and made their project ideas available to students so they could

Table 1. Fourth-Year Student Pharmacist Involvement in a Research Program and Resulting Scholarly Activities

Graduation year	2015	2016	2017	Average for 2015-2017	2018	2019	2020	Average for 2018-2020	P value ^a
Students assigned to health system, n	10	12	11	33	11	10	10	31	—
Students who participated in research, n (%)	5 (50)	6 (50)	5 (45.5)	16 (48.5)	10 (90.9)	7 (70.0)	10 (100)	27 (87.1)	
Students who did not participate in research, n (%)	5 (50)	6 (50)	6 (54.5)	17 (51.5)	1 (9.1)	3 (30)	0 (0)	4 (2.9)	.001
Number of projects per student, mean (SD)	0.7 (0.9)	0.5 (0.5)	0.5 (0.5)	0.5 (0.7)	0.9 (0.3)	0.7 (0.5)	1.8 (1.0)	1.1 (0.8)	.01
Dissemination per student, mean (SD)	1.3 (1.4)	1.2 (1.3)	1.1 (1.4)	1.2 (1.3)	2.7 (0.9)	1.8 (1.4)	3.4 (2.0)	2.7 (1.6)	<.001
Presentations, n (%) ^b	10 (76.9)	12 (85.7)	7 (63.6)	29 (76.3)	20 (69.0)	17 (89.4)	26 (74.3)	63 (75.9)	<.001
Poster presentations, n (%)	5 (50)	6 (50)	3 (42.9)	14 (48.3)	11 (55)	9 (52.9)	17 (65.4)	37 (58.7)	<.001
Podium presentations, n (%)	5 (50)	6 (50)	4 (57.1)	15 (51.7)	9 (45)	8 (47)	9 (34.6)	24 (38.1)	.002
Publications, n (%) ^b	3 (23.1)	2 (14.3)	4 (36.4)	9 (23.6)	9 (31.0)	2 (10.5)	9 (25.7)	20 (24.1)	0.0318
Peer-reviewed, n (%)	3 (100)	2 (100)	2 (50)	7 (77.8)	8 (88.9)	2 (100)	5 (55.6)	15 (75.0)	0.0183
Not peer-reviewed, n (%)	0 (0)	0 (0)	2 (50)	2 (22.2)	1 (11.1)	0 (0)	4 (44.4)	5 (25.0)	NS

^a2015-2017 compared to 2018-2020.

^bDenominator includes presentations and publications.

choose a topic that interested them. By May, students were matched to preceptors with projects that were potentially more feasible and fleshed out than in years past. We also did not require prior completion of prerequisite courses. We communicated resources throughout the year, which may have encouraged students to disseminate their research findings. This new approach is similar in ideology to the flipped residency research model, which was found to align better with resident experiences and abilities.⁸ In the flipped model, residents receive a list of projects that ideally have already been approved by IRB in July, are assigned to projects based on interests, complete data collection from July to October, analyze data from October to November, and present a professional poster and begin manuscript writing in December. Residents then develop new research proposals from January to March to ideally have IRB approval for those projects in time for subsequent residents. Since the time of our study, we have implemented a flipped model for students to be matched to preceptors soon after they are assigned to our health-system (during the fall of their third year), and we encourage preceptors to pursue IRB approval before May. We also support research for second and third year student pharmacists assigned to the

health system. Early exposure to research, as soon as the first year of pharmacy school, and increasing involvement with the goal of dissemination (posters, publications, presentations) by the fourth year, may improve the experience of student pharmacists and broaden their career opportunities.⁹

Michalets and colleagues described a similar study of a longitudinal research APPE (L-APPE) compared to cocurricular student-driven research, which highlighted the importance of structured support in research productivity.⁴ Comparatively, our health system is smaller with fewer clinical faculty, is not a satellite campus for the affiliated school of pharmacy, our implementation phase occurred during a different time period, and we did not provide course credit. We witnessed a greater increase in research participation (48.5% pre-implementation vs 87.1% post-implementation) compared to the L-APPE study (43.4% pre-implementation vs 40.2% post-implementation). This may have been influenced by increased professional competitiveness. Students pursuing postgraduate training may be instinctively more likely to participate in research. We did not evaluate students' motivation to participate in the research program, but we did observe a greater overall increase in the pursuit of training

Table 2. Fourth-Year Student Pharmacist Position Placement at Time of Graduation at a Community Teaching Health System

	2015	2016	2017	2015-2017	2018	2019	2020	2018-2020	Total
Students who participated in research, n (%)	5 (50)	6 (50)	5 (45.5)	16 (48.5)	10 (90.9)	7 (70.0)	10 (100)	27 (87.1)	43 (67.2)
Placement of student research participants, n (%)	NA	6 (100)	3 (60)	11 (NA)	8 (80)	7 (100)	10 (100)	25 (92.6)	36 (NA)
Students who pursued training, n (%)	2 (40)	5 (83.3)	4 (80)	11 (68.8)	9 (90)	7 (100)	10 (100)	26 (96.3)	37 (86.0)
Students who placed into training, n (%)	2 (100)	5 (100)	2 (50)	9 (81.8)	7 (77.8)	7 (100)	10 (100)	24 (92.3)	33 (89.2)
Students who pursued a job, n (%)	NR	1 (16.7)	1 (20)	2 (NA)	1 (10)	0 (0)	0 (0)	1 (3.7)	3 (NA)
Student who placed into a job, n (%)	NR	1 (100)	1 (100)	2 (NA)	1 (100)	NA	NA	1 (100)	3 (NA)
Students who did not participate in research, n (%)	5 (50)	6 (50)	6 (54.5)	17 (51.5)	1 (9.1)	3 (30)	0 (0)	4 (12.9)	21 (32.8)
Placement of students who did not participate in research, n (%)	NA	3 (50)	6 (100)	9 (NA)	1 (100)	2 (66.7)	NA	3 (75)	12 (NA)
Students who pursued training, n (%)	0 (0)	2 (33.3)	1 (16.7)	3 (17.6)	1 (100)	2 (66.7)	NA	3 (75)	6 (28.6)
Students who placed into training, n (%)	NA	1 (50)	1 (100)	2 (66.7)	1 (100)	1 (50)	NA	2 (66.7)	4 (66.7)
Students who pursued a job, n (%)	NR	4 (66.7)	5 (83.3)	9 (NA)	0 (0)	1 (33.3)	NA	1 (25)	10 (NA)
Students who placed into a job, n (%)	NR	2 (50)	5 (100)	7 (NA)	NA	1 (100)	NA	1 (100)	8 (NA)

Training, residency or fellowship; NR, not reported in 2015; NA, not applicable (2015 missing data or no students pursued training, 2019 all research students placed into training programs, 2020 all students participated in research)

programs among both students who participated in research (from 68.8% to 96.3%) and students who did not (from 17.6% to 75%). It is unclear whether our health system could have supported the influx of student researchers without the new process.

Other limitations of our study include small sample size, retrospective study design, and confounding factors (eg, increased competition in the profession, diverse student career interests, high academic and leadership performance influencing position placement). Job placement data were not recorded in 2015 but were in the following years. We also did not differentiate between local or national presentations, research projects conducted outside the health system, or impact on practice. Further, position placement after graduation and long-term career outcomes were not tracked.

To our knowledge, ours is the first study of a longitudinal student pharmacist research process that observed career placement. Although a causal relationship cannot be identified because of the limitations discussed, a numerical increase in placement rates into training programs (81.8% vs 92.3%) was seen among student pharmacists who participated in research. In contrast, the placement rates for students who did not participate in research remained unchanged. Notably, our postgraduate placement rate prior to implementation of the new research process was 81.8%, which was similar to the affiliated university match rate (81.6%).¹⁰ During the three years after implementation of the new research process, our postgraduate placement rate of 92.3% exceeded the university match rate (84.9%). This relationship warrants further investigation.

This study can be applied to other settings by exploring strategies, resources, relationships, or affiliations supporting student pharmacist research, including how they can best sustain and expand research opportunities for the growing numbers of student researchers, and their associated outcomes. Examples of outcomes to be explored include research participation and motivators, impact on practice, short-term and long-term career impact, scholarly activity, and perceptions of faculty and student participants. Different perspectives may also be considered, including those of layered learners, preceptors, administrators, research teams, patients, and interprofessional members. Institutions differ in resources and available data, but additional exploration can improve our understanding of how we can best support student pharmacist research training and its ripple effect on the profession.

CONCLUSION

A fourth-year student pharmacist research process supported a higher number of student research participants, research projects, presentations, and publications. Further investigation may clarify the relationship between student research support and career placement.

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